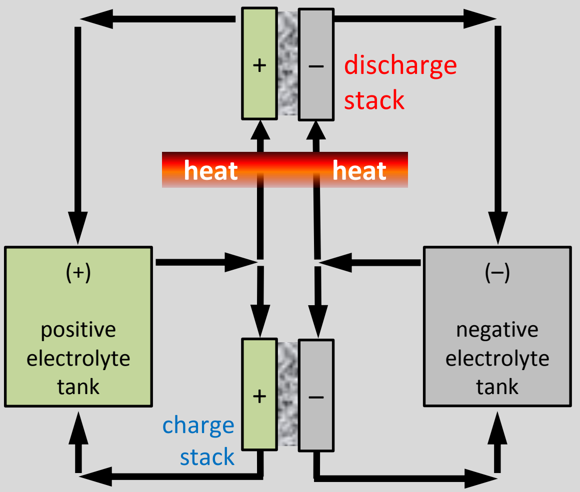
Thermoelectrochemical Energy Storage



Charge and discharge at different temperatures

Motivation:

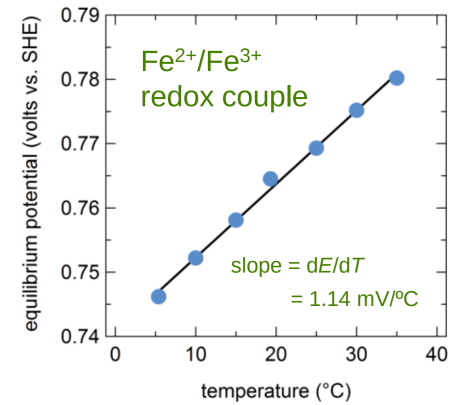
- Use low-grade waste heat to increase voltage efficiency of flow batteries
  - control stack temperature to decrease voltage required during charge and increase voltage output during discharge
- Thermal management must consider the thermodynamic dependence of voltage on temperature
- Proposed configuration:
  - one stack for charge
  - another stack for discharge
  - heat exchanger at inlet of one stack

$$-nFE^\circ = \Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

equilibrium potential (voltage)

$$\underbrace{\left.\frac{\partial E^\circ}{\partial T}\right|_P}_{\text{temperature coefficient (mV/}^o\text{C)}} = \frac{1}{nF}\Delta S^\circ$$

reaction entropy



FY11 Activities:

- Conducted literature survey of prior work
- Assessed existing thermodynamic data to identify candidate electrochemical reactions
- Identified two candidate system designs

FY12 Plans:

- Determine dependence of equilibrium potential on temperature (d*E*/d*T*) for typical flow cell reactions (e.g. all-vanadium, iron-chromium, zinc-bromine)
- Demonstrate the technical and economic feasibility of such a system

Nicholas Hudak, Sandia National Labs, nhudak@sandia.gov, (505) 844-2171